APPLICATION FOR NEW COURSE

1. Submitted by the College of Arts and Sciences Date: 10/04/01

Department/Division offering course: Statistics

2. Proposed designation and Bulletin description of this course:

(a) Prefix and Number: STA 705 (b) Title* Advanced Computational Inference (subt. req.)

*NOTE: If the title is longer than 24 characters (including spaces), write a sensible title (not exceeding 24 characters) for use in transcripts: Adv. Comp. Inference

(c) Lecture/Discussion hours per week 3 (d) Laboratory hours per week

(e) Studio hours per week

(f) Credits:

(g) Course description: Numerical maximization and integration, Resampling Methods, EM Algorithm, Markov Chain Monte Carlo Methods

(h) Prerequisites (if any): STA 601, STA 624

(i) May be repeated to a maximum of

4. To be cross-listed as:

Prefix & No. Signature, Chairman, cross-listing department

5. Effective Date: Fall, 2002 (semester and year)

6. Course to be offered: (a) Fall ☒ (b) Spring ☐ (c) Summer ☐

7. Will the course be offered each year? (a) Yes ☒ (b) No ☐

(Explain if not annually):

8. Why is this course needed: Computational techniques developed in the past 20 years are now fundamental tools for Statisticians faced with problems that cannot be analytically solved

9. (a) By whom will the course be taught? Kert Viele, Mai Zhou

(b) Are facilities for teaching the course now available? (a) Yes ☒ (b) No ☐

If not, what plans have been made for providing them?
10. What enrollment may be reasonably anticipated? **5-10**

11. Will this course serve students in the Department primarily? (a) Yes ☒ (b) No ☐
   Will it be of service to a significant number of students outside the Department? (a) Yes ☐ (b) No ☒
   If so, explain: ________________________________________________________________

12. Check the category most applicable to this course:
   ☐ traditional; offered in corresponding departments elsewhere;
   ☒ relatively new, now being widely established
   ☐ not yet to be found in many (or any) other universities

13. Is this course part of a proposed new program? (a) Yes ☒ (b) No ☐
   If yes, which? **Statistics/Probability and Biostatistics tracts within the Statistics Ph.D.**

14. Will adding this course change the degree requirements in one or more programs?* (a) Yes ☒ (b) No ☐
   If yes, explain the change(s) below: **This course will be part of the core curriculum for the Ph. D. in Statistics**

15. Attach a list of the major teaching objectives of the proposed course, outline and/or reference list to be used.

16. If the course is a 100-200 level course, please submit evidence (e.g., correspondence) that the Community College System has been consulted.

17. Within the Department, who should be contacted for further information about the proposed course?
   Name/e-mail: **Arnold J. Stromberg, DGS**
   Phone Extension: **7-6903**

*NOTE: Approval of this course will constitute approval of the program change unless other program modifications are proposed.
**Signatures of Approval:**

- **Constance H. Wood**  
  Department Chair
- **Philip H. Solomon**  
  Dean of the College

**Date**  
03/26/02

**Date of Notice to the Faculty**  
APR 09 2002

- **Undergraduate Council**
- **University Studies**
- **Graduate Council**
- **Academic Council for the Medical Center**
- **Senate Council**

*If applicable, as provided by the Rules of the University Senate

**Date of Notice to Univ. Senate**  
MAR 28 2002

**ACTION OTHER THAN APPROVAL:**
Course Description for STA705

Advanced Computational Inference


Teaching Objectives:

1. **EM Algorithm.** Students should be familiar with the calculations required to implement the EM algorithm, the theoretical justification behind those calculations, and be able to implement the EM algorithm in a variety of contexts, for example mixture models. Students should also recognize the limitations of the EM algorithm for example that convergence is potentially to a local mode instead of the global maximum.

2. **Resampling.** Students should understand the basic idea of the bootstrap and jackknife. Students should also be able to implement the bootstrap using techniques for sampling from the empirical distribution.

3. **Markov Chain Monte Carlo (MCMC)** Students should be able to implement Markov Chain Monte Carlo methods. This will involve choosing starting values, assessing convergence of the chain, computing estimates of expectations, and computing the variance of those estimates by viewing the Markov Chain as an AR(1) process.

These methods require a variety of computational methods to implement. Thus, as necessary the course will discuss programming in a statistical package, numerical maximization through the Newton-Raphson algorithm, genetic algorithms, numerical integration techniques, and Monte Carlo integration techniques such as rejection importance sampling.

Nature of Assignments and Grading Criteria:

Weekly Homework – 25%
2 Midterms – 25% each. The exams consist of a take home portion and an inclass portion. In the take home portion they are supposed to analytically solve a complicated problem and then implement the solution. The inclass portion consists of solving and implementing some minor adjustment to the takehome portion.
Final – 25%

Grading Scale:
90-100 – A
80-90 – B
70-80 – C
Below 70 – E
At his or her discretion, the instructor may use a curve.
INVESTIGATOR REPORT

INVESTIGATING BODY  Area A, Shelley Steiner  COURSE MAJOR or DEGREE  STA 705
(Area, Area Chair)  (department or college)

DATE FOR COUNCIL REVIEW  4/9/02  CATEGORY: NEW, CHANGE, DROP

INSTRUCTIONS: This completed form will accompany the course application to the Graduate/Undergraduate Council(s) in order to avoid needless repetition of investigation. The following questions are included as an outline only. Be as specific and as brief as possible. If the investigation was routine, please indicate this. The term "course" is used to indicate one course, a series of courses or a program, whichever is in order. Return the form to Phil Harling, Associate Dean, 231 Patterson Office Tower for forwarding to the Council(s). ATTACH SUPPLEMENT IF NEEDED.

1. List any modifications made in the course proposal as submitted originally and why.

   None

2. If no modifications were made, review considerations that arose during the investigation and the resolutions.

3. List contacts with program units on the proposal and the considerations discussed therein.

   Dr. Wood & Area A Committee member

4. Additional information as needed.

   None

5. A&S Area A, Natural & Mathematical Sciences Curriculum Committee Recommendation:

   [ ] APPROVE  [ ] APPROVE WITH RESERVATION  [ ] DISAPPROVE

6. A&S Council Recommendation:

   [ ] APPROVE  [ ] APPROVE WITH RESERVATION  [ ] DISAPPROVE

7. A&S Council Investigator, Dr. Shelley Steiner

   Date: 4-9-02

File: InvestigatorRpt